FINAL
FIELD SAMPLING PLAN FOR
AREA 1

OF THE
CAMP EDWARDS IMPACT AREA
GROUNDWATER QUALITY STUDY

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

Prepared for

NATIONAL GUARD BUREAU
ARLINGTON, VIRGINIA

Prepared by

OGDEN ENVIRONMENTAL AND ENERGY SERVICES
239 Littleton Road, Suite 1B
Westford, Massachusetts 01886

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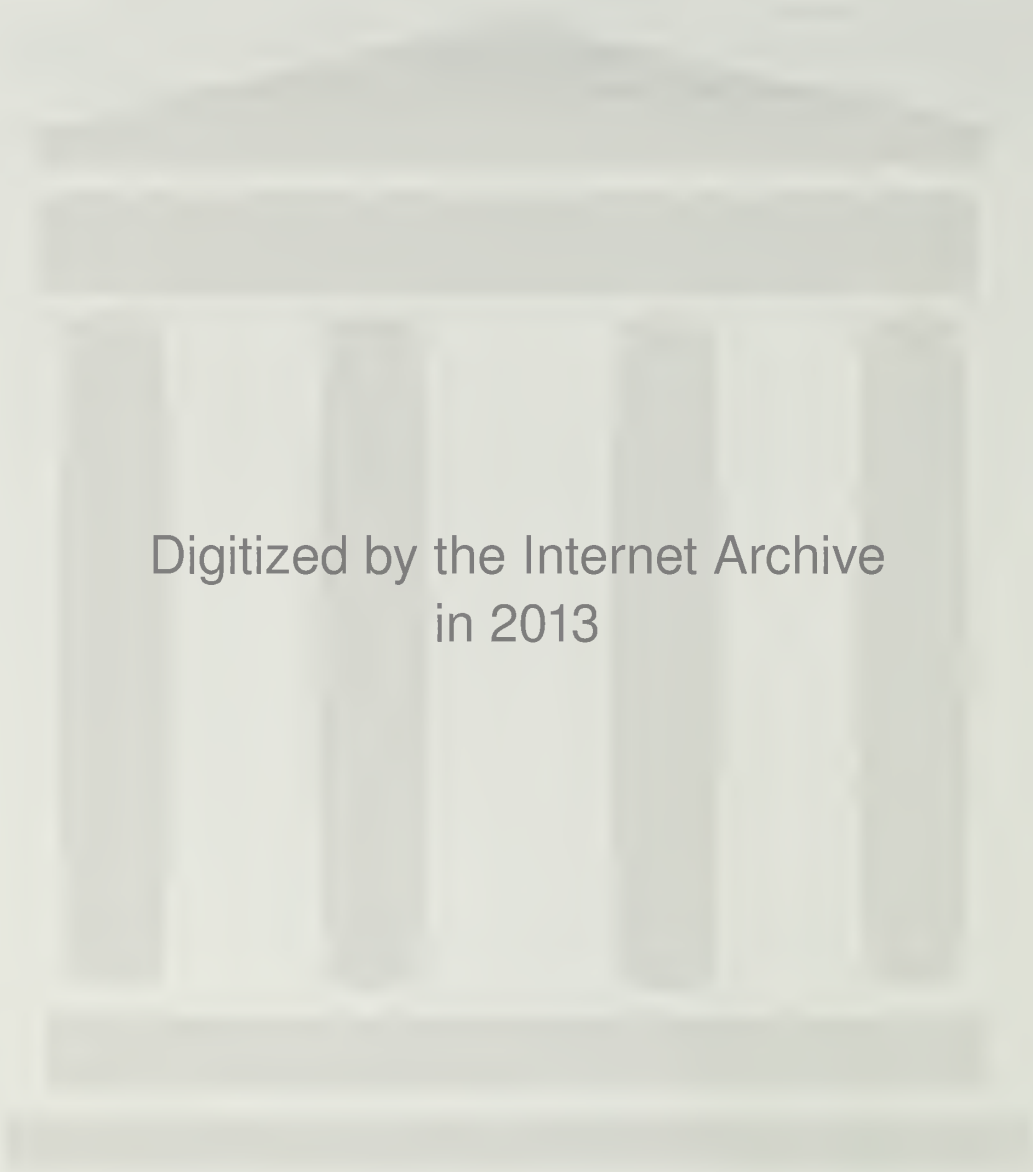
DISCLAIMER:

This document has been prepared pursuant to a government administrative order (U.S. EPA Region I SDWA Docket No. I-97-1019) and is subject to approval by the U.S. Environmental Protection Agency. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.



A.7 Area 1 Field Sampling Plan

A.7.1 Background and Focal Area(s)

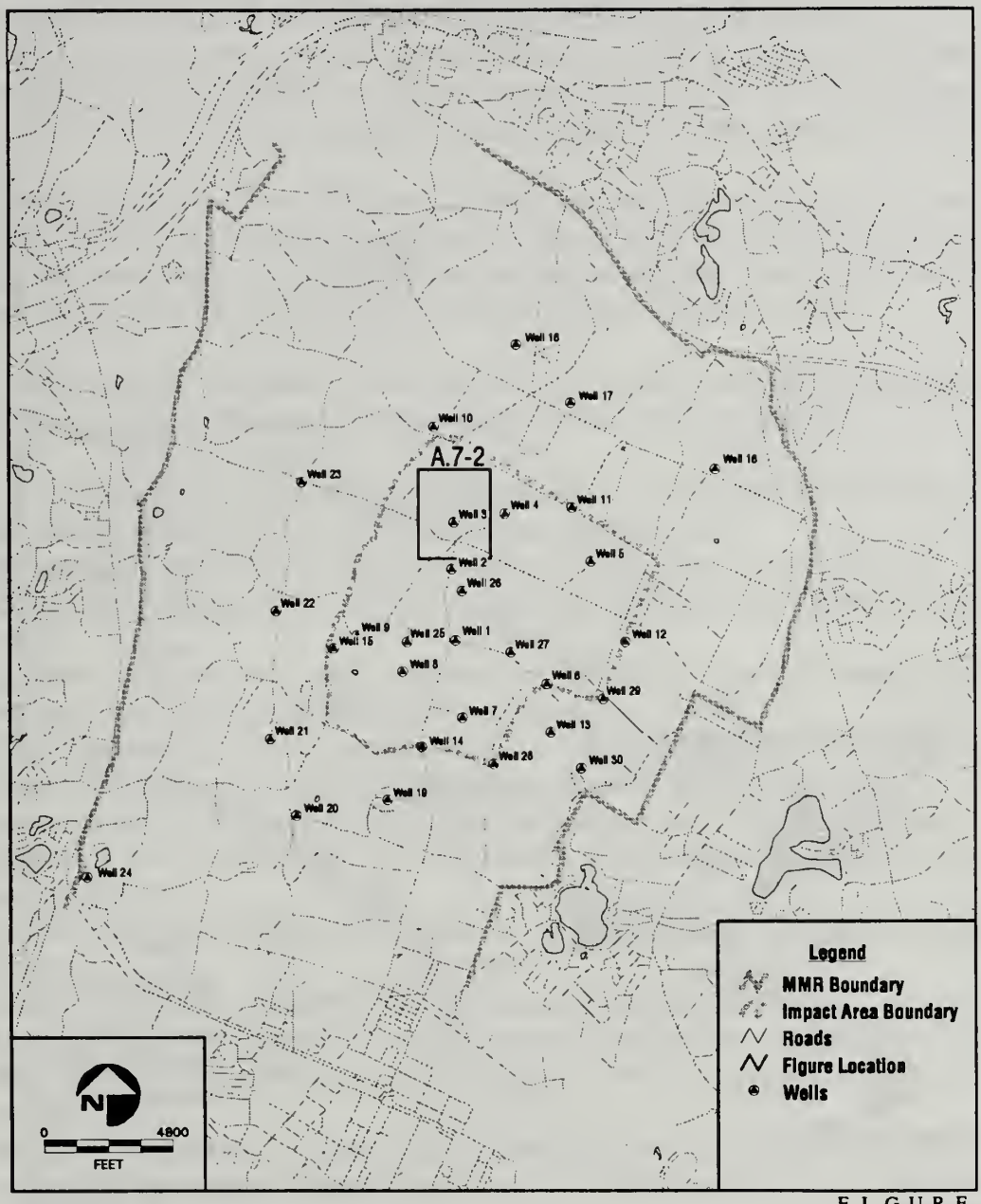
Area 1 is located north of the Five Corners area as seen in Figure A.7-1. Area 1 is comprised of two focal areas as illustrated in Figure A.7-2:

- A ground scar with two larger topographic depressions on its south side and several smaller depressions on its north side. This area appears to include impact craters as seen in aerial photographs from 1977. The estimated size of this area is 9 acres. The scar may have been created by burning related to firing practices. The area is completely revegetated.
- A ground scar on the north side of Wood Road that is apparent in aerial photographs from 1977. The estimated size of this area is 0.5 acre. This level area drops off steeply to the topographic depression. Information from interviews suggests that this area may have been used to dump material into the topographic depression. A clear area is still visible in the western portion of the level area.

A.7.2 Sampling & Analysis Methods

Area 1 sampling will include surface soil at each focal area based on the potential release of contaminants at ground surface. Area 1 sampling will include subsurface soil and groundwater at the topographic depression focal area based on the potential for contaminants to migrate into deeper soils or groundwater. All 0-6" and 18-24" soil samples will be collected in areas which are undisturbed by excavation or road building activities.

Sample collection will be consistent with MMR SOPs, the Ogden Health and Safety Guidelines, Attachment A: Field Guide to High Explosives, and the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities (October 31, 1996). Area 1 is within the Impact Area, therefore all samples with detectable levels of explosives by the colorimetric analysis will be analyzed by EPA Method 8330. **All borings and hand auger locations in Area 1 are subject to UXO clearance requirements.**



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MMR - Area 1 Vicinity Map

FIGURE
A.7-1

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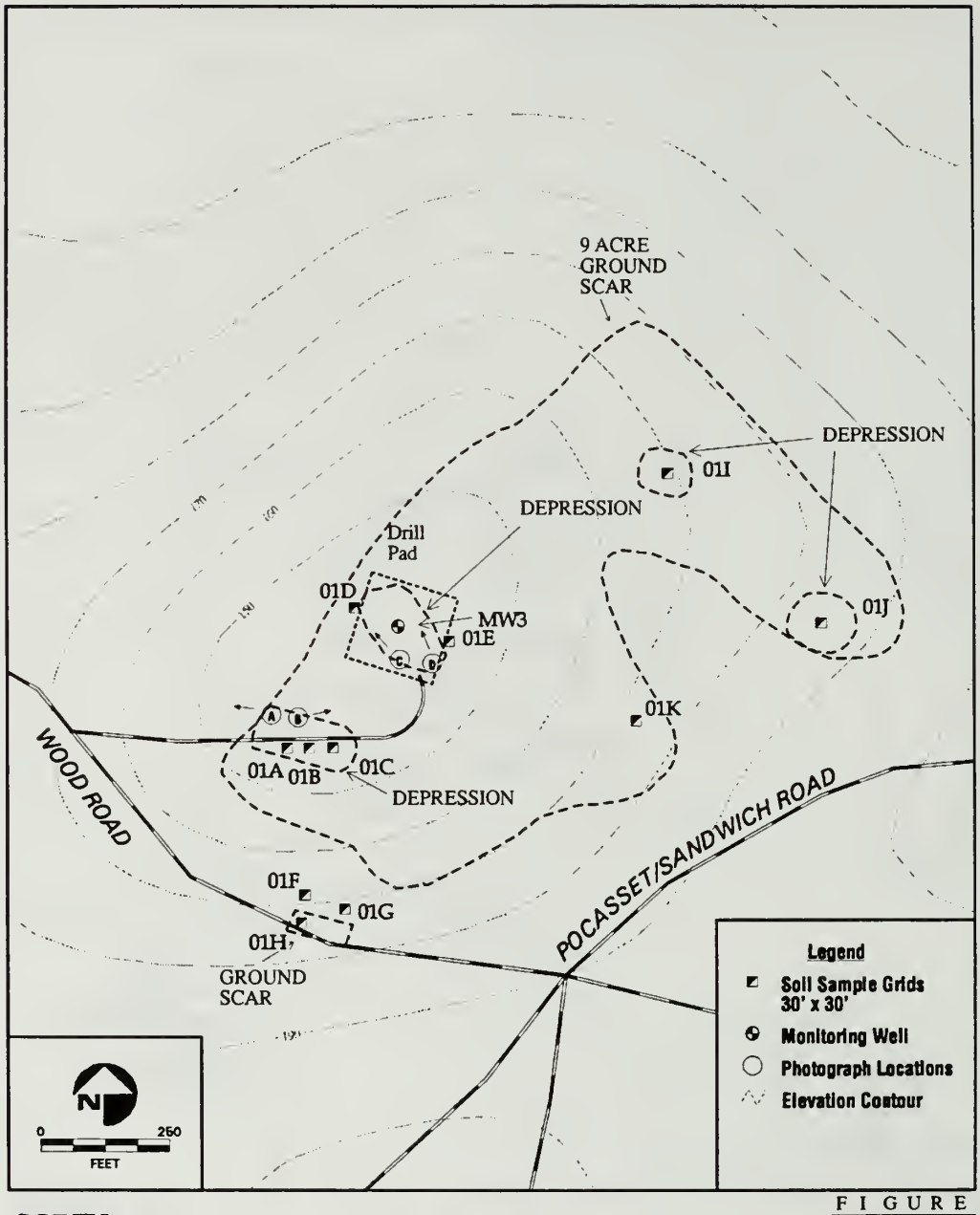

FIGURE

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Area 1 Sampling Points

A.7-2

Hand Augering

A representative portion of each focal area will be sampled, as indicated in Figure A.7-2. Following is the distribution of soil sampling grids in each of the focal areas:

- A representative portion of the 9-acre ground scar, consisting of three grids in the southern portion (01A-01C), two grids in the northern portion (01D-01E) and one grid in each of the impact craters in the northern portion of the ground scar (01I-01J).

- Three grids (01F-01H) will be placed at the ground scar focal area north of Wood Road. Two of the soil sampling grids will be placed along the north sloping edge of the level area to characterize the location where dumping is suspected, and one grid will be placed in the clear area in the western portion of the level area.

Each soil boring grid will consist of nine sample points spaced ten feet apart as illustrated in Figure A.7-3. The following protocol will be followed for hand augering:

1. A 0-6" soil sample will be collected from each of the nine sample points in a grid;
2. soil from each sample point will be placed in a headspace jar;
3. the remaining soil from each of the nine sample points will be composited in accordance with Section 8.1 of the EPA Standard Guide and Attachment A of this FSP;
4. headspace measurements will be collected from each of the nine 0-6" samples and recorded in the space provided on the hand auger log;
5. a VOC grab sample will be collected from one sample point based on the following priority of observations: 1)highest response on the FID, 2) visual signs of contamination, 3) the central grid location (a fresh soil sample will be collected adjacent to the sample point). The VOC sample will be collected within one foot of the FID sample;
6. the 0-6" composite sample will be submitted for explosives and inorganics, and other analytes;
7. when the analytical results from the 0-6" sample are available, an 18-24" sample will be collected and composited as described above for explosives and inorganics. Any other analytes that are detected in the 0-6" sample will be analyzed from the 18-24" sample;
8. an 18-24" sample will be selected for VOC analysis based on screening with an FID as described in steps 1-5 above.

Figure A.7-3: Plan of Soil Sampling Grid:
Soil Sampling Point:
0"
6"
18"
24"
0-6" Sample
submitted for:
Inorganics
Explosives
other analytes
Composite
VOC - Grab
18-24" Sample
submitted for:
Inorganics
Explosives
Composite
VOC - Grab
submitted if
detected in 0-6":
other analytes - Composite
10'
5'
30'

Barber Rig Drilling

A boring will be advanced to bedrock within the northern depression of focal area 1 indicated in Figure A.7-1, and completed as a nested shallow and deep monitoring well (MW-3). An intermediate depth well will be completed in an adjacent boring at a depth based on the VOC and explosives screening of groundwater for the initial boring. The decision on well depth will be made in consultation with EPA.

Prior to the onset of the investigation, the site will be intrusively cleared of UXO to a depth of two feet below grade. Additional clearance will occur from a depth of two feet to 10 feet below grade. Under this procedure, a down-hole magnetometer will be lowered into the hole prior to advancing the auger in two-foot intervals. After completion of the next two-foot interval, 4" PVC will be inserted into the borehole and the rig will be moved off of the hole prior to magnetic survey of the next interval. The boring location will be considered clear when a depth of ten feet is reached without encountering any magnetic anomalies (clearance to 12 feet).

The following protocol will be observed while drilling in the Impact Area:

1. A 0-6" sample will be collected and submitted for explosives, inorganics, and all other analytes;
2. From ten feet below grade until the water table is encountered, a soil sample will be collected every ten feet using a split spoon;
3. The 10-12' interval will be FID screened and submitted for explosives, inorganics, and other analytes;
4. The 20-22' interval will be FID screened and submitted for explosives, and inorganics;
5. Each sample below the 20-22' interval will be screened with an FID and sampled for explosives (submitted ON HOLD) and inorganic analysis;
6. The soil samples submitted ON HOLD for explosives will be analyzed only if explosives are detected in the 10-12' or 20-22' sample interval; and
7. Each sample at and below the 20-22' interval will be sampled for the other analytes only if there is a response on the FID.
8. An 18-24" hand auger sample will be collected and submitted for explosives and inorganics after the results for the 0-6" sample are received;
9. The 18-24" hand auger sample will also be submitted for any other analytes which are detected in the 0-6" sample;
10. The boring will be advanced 15 into bedrock in order to confirm that bedrock has

been encountered.

From the water table to the completion of the boring, soil will be sampled from the cyclone for lithology. Groundwater samples will be collected at every ten feet during advancement of the borings and will be submitted for laboratory analysis of explosives and VOCs. Wells will be screened as described in Section 4.2.2 of the Action Plan.

Table A.7-1 lists sample numbers and analytical requirements for the areas to be investigated.

Table A.7-1: MMR Subsurface Soil Samples from Borings					Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Loc.	Depth	MMR ID	EPA/Ogden ID	Cont.	8oz	8oz	8oz		4oz	8 oz			4oz	
1	MW3	A(0-6")	71MS03DXAX01XA	S03DAA		X		X		X	X	X	X	X	X
		B(18-24")	71MS03DXBX01XA	S03DBA		@		@		@	@	@	@	@	@
		C(10-12')	71MS03DXCX01XA	S03DCA		X		X		X	X	X	X	X	X
		D(20-22')	71MS03DXDX01XA	S03DDA		X		X		*	*	*	*	*	*
		E	71MS03DXEX01XA	S03DEA		#		X		*	*	*	*	*	*
		F	71MS03DXFX01XA	S03DFA		#		X		*	*	*	*	*	*
		G	71MS03DXGX01XA	S03DGA		#		X		*	*	*	*	*	*
		H	71MS03DXHX01XA	S03DHA		#		X		*	*	*	*	*	*
		I	71MS03DXIX01XA	S03DIA		#		X		*	*	*	*	*	*
		J	71MS03DXJX01XA	S03DJA		#		X		*	*	*	*	*	*
		K	71MS03DXKX01XA	S03DKA		#		X		*	*	*	*	*	*
		L	71MS03DXLX01XA	S03DLA		#		X		*	*	*	*	*	*
		M	71MS03DXMX01XA	S03DMA		#		X		*	*	*	*	*	*

X - collect and submit

- collect and submit ON HOLD

@ - to be sampled after the results of the 0-6" sample are received

@ - to be collected if detected in the 0-6" sample

* - collect and submitted only if there is an FID response.

Table A.7-1: MMR Soil Samples from Hand Auger Grids						Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Grid	Depth	Type	MMR ID	EPA/Ogden ID	Cont:	8oz	8oz	8oz		4 oz	8 oz			4 oz*	
1	01A	0-6	grab	71BS01AXAX01XA	B01AAA						X					
			comp	71BS01AXAX01XA	B01AAA		X		X			X	X	X	X	X
		18-24	grab	71BS01AXBX01XA	B01ABA						#					
			comp	71BS01AXBX01XA	B01ABA		O		O			#	#	#	#	#
	01B	0-6	grab	71BS01BXAX01XA	B01BAA						X					
			comp	71BS01BXAX01XA	B01BAA		X		X			X	X	X	X	X
		18-24	grab	71BS01BXBX01XA	B01BBA						#					
			comp	71BS01BXBX01XA	B01BBA		O		O			#	#	#	#	#
	01C	0-6	grab	71BS01CXAX01XA	B01CAA						X					
			comp	71BS01CXAX01XA	B01CAA		X		X			X	X	X	X	X
		18-24	grab	71BS01CXBX01XA	B01CBA						#					
			comp	71BS01CXBX01XA	B01CBA		O		O			#	#	#	#	#
	01D	0-6	grab	71BS01DXAX01XA	B01DAA						X					
			comp	71BS01DXAX01XA	B01DAA		X		X			X	X	X	X	X
		18-24	grab	71BS01DXBX01XA	B01DBA						#					
			comp	71BS01DXBX01XA	B01DBA		O		O			#	#	#	#	#
	01E	0-6	grab	71BS01EXAX01XA	B01EAA						X					
			comp	71BS01EXAX01XA	B01EAA		X		X			X	X	X	X	X
		18-24	grab	71BS01EXBX01XA	B01EBA						#					
			comp	71BS01EXBX01XA	B01EBA		O		O			#	#	#	#	#
	01F	0-6	grab	71BS01FXAX01XA	B01FAA						X					
			comp	71BS01FXAX01XA	B01FAA		X		X			X	X	X	X	X
		18-24	grab	71BS01FXBX01XA	B01FBA						#					
			comp	71BS01FXBX01XA	B01FBA		O		O			#	#	#	#	#
	01G	0-6	grab	71BS01GXAX01XA	B01GAA						X					
			comp	71BS01GXAX01XA	B01GAA		X		X			X	X	X	X	X
		18-24	grab	71BS01GXBX01XA	B01GBA						#					
			comp	71BS01GXBX01XA	B01GBA		O		O			#	#	#	#	#
	01H	0-6	grab	71BS01HXAX01XA	B01HAA						X					
			comp	71BS01HXAX01XA	B01HAA		X		X			X	X	X	X	X
		18-24	grab	71BS01HXBX01XA	B01HBA						#					
			comp	71BS01HXBX01XA	B01HBA		O		O			#	#	#	#	#
	01I	0-6	grab	71BS01IXAX01XA	B01IAA						X					
			comp	71BS01IXAX01XA	B01IAA		X		X			X	X	X	X	X
		18-24	grab	71BS01IXBX01XA	B01IBA						#					
			comp	71BS01IXBX01XA	B01IBA		O		O			#	#	#	#	#
	01J	0-6	grab	71BS01JXAX01XA	B01JAA						X					
			comp	71BS01JXAX01XA	B01JAA		X		X			X	X	X	X	X
		18-24	grab	71BS01JXBX01XA	B01JBA						#					
			comp	71BS01JXBX01XA	B01JBA		O		O			#	#	#	#	#

X = to be collected and submitted to laboratory

O = to be sampled and submitted after the results from the 0-6" sample are received

= to be collected if detected in the 0-6" sample

Table A.7-1: MMR Groundwater Samples from Borings					Parameters:	Explosives (8330 Screen)	Explosives (EPA 8330)	Inorganics	Metals (filtered)	Cyanide	Phos.,NO3, NO4, NH4	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
			MMR	EPA/Ogden	Cont:	250mL	2*1L		500mL	1L	1L		3*40mL	2*1L	2*1L	2*1L	3*40mL	3*40mL
Area	Loc.	Depth	ID	ID	Pres:	none	none		HNO3	NaOH	H2SO4		HCl	none	none	none	HCL	thioS
1	MW3	A	71GB03DXAX01XA	G03DAA		X							X					
		B	71GB03DXBX01XA	G03DBA		X							X					
		C	71GB03DXCX01XA	G03DCA		X							X					
		D	71GB03DXDX01XA	G03DDA		X							X					
		E	71GB03DXEX01XA	G03DEA		X							X					
		F	71GB03DXFX01XA	G03DFA		X							X					
		G	71GB03DXGX01XA	G03DGA		X							X					
		H	71GB03DXHX01XA	G03DHA		X							X					
		I	71GB03DXIX01XA	G03DIA		X							X					
		J	71GB03DXJX01XA	G03DJA		X							X					
		K	71GB03DXKX01XA	G03KA		X							X					
		L	71GB03DXLX01XA	G03DLA		X							X					
		M	71GB03DXMX01XA	G03DMA		X							X					
		N	71GB03DXNX01XA	G03DNA		X							X					
		O	71GB03DXOX01XA	G03DOA		X							X					
X = to be collected and submitted to laboratory																		

Photograph A: Looking west from the southern depression along the access road.

Photograph B: Looking east from the southern depression along the access road.

Photograph C: Looking northwest from the northern depression.

Photograph D: Looking north from the northern depression.

ATTACHMENT A: FIELD GUIDE TO HIGH EXPLOSIVES

Any substance encountered during sampling activities which differs in any way from natural media will be treated as a dangerous substance, carefully removed from the sample, and set aside.

EXPLOSIVES

NAME	DESCRIPTION	REMARKS
BLACK POWDER	BROWN TO BLACK	MANUFACTURED IN GRAINS THAT RANGE IN SIZE FROM SMALLER THAN SALT GRAINS TO GRAINS AS LARGE AS SMALL PEBBLES. HIGHLY SENSITIVE TO IGNITION BY HEAT, FRICTION, FLAME, SPARK. WHEN WET, IT IS CORROSIVE TO MOST METALS.
TNT	LIGHT YELLOW TO BROWN OR GRAY	LIGHTLY CORROSIVE WITH LEAD. USED IN BOMBS, GRENADES, DEMOLITION CHARGES, PROJECTILES. EXUDES AT ELEVATED TEMPERATURES. MODERATELY TOXIC BY SKIN ABSORPTION OR INHALATION.
EXPLOSIVE D	BRIGHT YELLOW TO ORANGE. ALSO CALLED AMMONIUM PICRATE.	RELATIVELY INSENSITIVE. HIGHLY TOXIC BY INHALATION, INGESTION, OR SKIN ABSORPTION
AMATOL	LIGHT BROWN TO YELLOW/MIXTURE OF TNT AND EXPLOSIVE D	SLIGHT HYGROSCOPIC. HAS CORROSIVE EFFECTS ON COPPER, BRONZE, LEAD, BRASS. HIGHLY TOXIC BY INHALATION, SKIN CONTACT, INGESTION.
COMPOSITION B	WHITE TO BROWNISH YELLOW, MIXTURE OF TNT AND EXPLOSIVE D	SLIGHTLY CORRODES COPPER, BRASS, CADMIUM, ZINC. USED IN BOMBS, PROJECTILES, GRENADES, SHAPED CHARGES.
OCTOL	LIGHT BROWN	USED IN BOMBS, PROJECTILES, SHAPED CHARGES.
RDX	WHITE. ALSO CALLED CYCLONITE	SENSITIVE TO IMPACT AND FRICTION.SLIGHTLY CORROSIVE WITH COPPER, BRASS, MILD STEEL, CADMIUM. MODERATELY TOXIC BY INHALATION OR INGESTION.
HMX	WHITE. ALSO CALLED OCTOGEN	SENSITIVE TO IMPACT AND FRICTION. SLIGHTLY TOXIC.
PETN	WHITE	SENSITIVE TO IMPACT. SLIGHTLY CORROSIVE TO BRASS, CADMIUM, ZINC. VERY SLIGHTLY TOXIC.

EXPLOSIVES, continued

NAME	DESCRIPTION	REMARKS
LEAD AZIDE	WHITE TO LIGHT BROWN	VERY SENSITIVE TO IMPACT, FRICTION, SPARKS. CORROSIVE TO COPPER, ZINC. VERY SLIGHTLY TOXIC.
LEAD STYPHNATE	LIGHT ORANGE TO REDDISH BROWN	SAME AS LEAD AZIDE.
MERCURY FULMINATE	GRAYISH	VERY SENSITIVE TO IMPACT, FRICTION, SPARKS. CORROSIVE TO ALUMINUM, MAGNESIUM, BRONZE, COPPER, ZINC, BRASS. HIGHLY TOXIC THROUGH SKIN ABSORPTION, INHALATION, INGESTION. SYMPTOMS RESEMBLE MERCURY POISONING.

PYROTECHNIC AGENTS USED AT MMR

SYMBOL	COMMON NAME	VISUAL IDENTIFICATION	ACTION
CS	NONE	WHITE CRYSTALLINE SOLID	TEAR AGENT
HC	HEXACHORO-ETHANE	WHITE SOLID	SCREENING SMOKE
WP	WHITE PHOSPHOROUS	PALE YELLOW SOLID	SCREEN SMOKE AND INCENDIARY
RP	RED PHOSPHOROUS	REDDISH BROWN POWDER	SCREENING SMOKE

OTHER COMPOUNDS

NAME	PROPERTIES	STABILITY
Picric Acid	lemon-yellow crystalline solid	very sensitive to blows or friction
Tetryl	fine yellow crystalline powder	sensitive to blows or friction
Composition A	unknown	unknown
Composition C3	unknown	unknown
Composition C4	unknown	unknown
Pentolite (50/50)	unknown	unknown
Tracer Compound	unknown	unknown
PBX	unknown	unknown
Ednatol	unknown	unknown
Tetrytol	unknown	unknown